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A

NEW UNITED STATES UTILITY PATENT APPLICATION
under 37 C.F.R. 1.53(b)

Page 1

Atty. Docket No. 3797.85751

CERTIFICATE OF EXPRESS MAILING UNDER 37 C.F.R. § 1.10: The undersigned hereby certifies that this United States Patent Application and all papers noted herein as being attached, are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" Service under 37 C.F.R. § 1.10 today, June 27, 2000, and is addressed to: Assistant Commissioner for Patents, Washington, D.C. 20231.

Express Mail Label No.: EL625291889US

JCS 60 U.S. PTO
09/604365
06/27/00

Assistant Commissioner for Patents
Box Patent Applications
Washington, D.C. 20231

Enclosed herewith is a new patent application and the following papers:

First Named Inventor (or application identifier): Georgios Chrysanthakopoulos

Title of Invention: Device Driver Auto-Load

1. Specification 17 pages (including specification, claims, abstract) / 23 claims (4 independent)
2. Declaration/Power of Attorney is:
 attached in the regular manner.
 NOT included, but deferred under 37 C.F.R. § 1.53(f).
3. 3 Distinct sheets of Formal Informal Drawings
4. Preliminary Amendment.
5. Information Disclosure Statement
 Form 1449
 A copy of each cited prior art reference
6. Assignment with Cover Sheet.
7. Priority is hereby claimed under 35 U.S.C. § 119 based upon the following application(s):

Country	Application Number	Date of Filing (day, month, year)
USA	09/159,522	23-09-98

8. Priority document(s).

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9. Statement Claiming Small Entity Status.
10. Microfiche Computer Program (Appendix).
11. Nucleotide and/or Amino Acid Sequence Submission.
 - Computer Readable Copy.
 - Paper Copy (identical to computer copy).
 - Statement verifying identity of above copies.
12. Calculation of Fees:

FEES FOR	EXCESS CLAIMS	FEE	AMOUNT DUE
Basic Filing Fee (37 C.F.R. § 1.16(a))			\$690.00
Total Claims in Excess of 20 (37 C.F.R. § 1.16(c))	3	18.00	\$54.00
Independent Claims in Excess of 3 (37 C.F.R. § 1.16(b))	1	78.00	\$78.00
Multiple Dependent Claims (37 C.F.R. § 1.16(d))	0	260.00	\$0.00
Subtotal - Filing Fee Due			\$822.00
		MULTIPLY BY	
Reduction by 50%, if Small Entity (37 C.F.R. §§ 1.9, 1.27, 1.28)	0		\$0.00
TOTAL FILING FEE DUE			\$822.00
Assignment Recordation Fee (if applicable) (37 C.F.R. § 1.21(h))	0	40.00	\$0.00
GRAND TOTAL DUE			\$822.00

13. PAYMENT is:

- A general authorization under 37 C.F.R. § 1.25(b), second sentence, is hereby given to credit or debit our Deposit Account No. 19-0733 for the instant filing and for any other fees during the pendency of this application under 37 C.F.R. §§ 1.16, 1.17 and 1.18.
- not included, but deferred under 37 C.F.R. § 1.53(f).

NEW UNITED STATES UTILITY PATENT APPLICATION
under 37 C.F.R. 1.53(b)

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Atty. Docket No. 3797.85751

14. All correspondence for the attached application should be directed to:

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JC498 U.S. PRO
09/604365

06/27/00

15. Other: Return Postcard

Date: June 27, 2000

By: *Tim Meece*
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Reg. No. 38,553

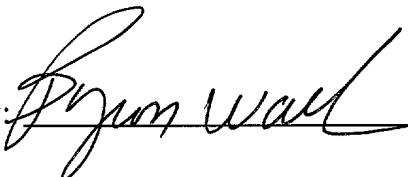
TCM/dmc

**CERTIFICATE OF MAILING
(PATENT)**

Express Mail No. EL625291889US

Deposited **June 27, 2000**

I hereby certify that the attached correspondence, identified below, is being deposited with the United States Postal Service as "Express Mail Post Office to Addressee" under 37 CFR 1.10 on the date indicated above and is addressed to the Assistant Commissioner for Patents, Box Patent Applications, Washington, D.C. 20231.

By: 
Jim Ward

Application of: Chrysanthakopoulos, et al.

Serial No.: not assigned

Filed: June 27, 2000

Title: Device Driver Auto-Load

- Specification 17 pages, including claims and abstract
- Declaration/Power of Attorney
- Assignment with Cover Sheet
- IDS with Form 1449 and copy of cited reference
- Three sheets of Formal drawings
- Check in the amount of \$0.00
- Return Postcard

B&W Case No.: 3797.85751 - TCM

DEVICE DRIVER AUTO-LOAD

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of U.S. Patent Application Serial No. 09/159,522 entitled "Solid-State Memory Device that Emulates a Known Storage Device," which was filed on September 23, 1998, the specification and drawings of which are incorporated herein by reference in their entirety.

FIELD OF THE INVENTION

This invention relates to automatic loading of device drivers. In particular, this invention pertains to a method and apparatus for automatically loading drivers for devices coupled to a communication medium such as an IEEE 1394 serial bus.

BACKGROUND OF THE INVENTION

A device driver is a program routine that links a peripheral device to an operating system running on a computer. It is written by programmers who understand the detailed knowledge of the device's command language and characteristics and contains the precise machine language necessary to perform the functions requested by the application. Every peripheral device requires a driver. The drivers provide the detailed instructions necessary to activate and control the device.

When a new hardware device is added to the computer, such as a display adapter, sound card or CD-ROM drive, its driver must be installed in order to run it. Similarly, when a new peripheral device is connected to one or more computers through a communication medium such as a serial bus, a driver for the peripheral device must be installed for each operating system on each computer. In either case, the operating system calls the driver, and the driver "drives" the device.

Unfortunately, manufacturers generally provide drivers for peripheral devices on floppy disks or CD-ROMs. Thus, whenever a new device is to be installed on a

computer, the operating system prompts the user to insert the computer-readable medium containing the appropriate driver. This is especially problematic when the peripheral device is coupled to a serial bus such as an IEEE 1394 (e.g. FireWire™, I.LINK™) bus, where multiple computers may need to simultaneously or sequentially 5 load drivers for the device.

Accordingly, it is an object of the present invention to provide methods and apparatus for automatically loading drivers for devices coupled to a communication medium such as an IEEE 1394 serial bus.

10

SUMMARY OF THE INVENTION

The present invention can be broadly summarized as follows. In a system including at least one computer and at least one device having at least one driver stored in memory on the device, the computer and device coupled through a communication medium, the present invention provides a method of automatically 15 loading the driver. The computer detects when the device is connected to the communication medium. The computer determines whether a suitable driver is stored in memory on the device. If the driver is correct for usage with the computer, the computer loads the driver from the memory on the device.

Of course, the methods and computer-executable instructions of this 20 embodiment may also include other additional components and/or steps.

Other embodiments are disclosed and claimed herein as well.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention may take physical form in certain parts and steps, embodiments of which will be described in detail in this specification and illustrated in the accompanying drawings which form a part hereof, wherein:

FIG. 1 is a schematic block diagram of a conventional general-purpose digital
5 computing environment that can be used to implement various aspects of the present
invention.

FIG. 2 is a schematic block diagram of an exemplary IEEE 1394 system
architecture capable of being used in conjunction with the present invention.

FIG. 3 is a flow chart illustrating an exemplary process of automatically
10 loading device drivers.

DETAILED DESCRIPTION OF THE INVENTION

The present invention provides an automated solution for installing device drivers for IEEE 1394 enabled devices. In particular, this invention overcomes the
15 problems of the prior art by preferably storing device drivers (and/or other installation/configuration files) for one or more operating systems on a peripheral device's configuration ROM (CROM) or other non-volatile memory. When the device is connected to a IEEE 1394 bus, each computer's operating system will automatically detect the device and read certain key information of the device CROM
20 to determine whether the driver information is stored in the CROM. If the device is a legacy device, the user is instructed to manually load the requisite drivers. If the device is manufactured in accordance with the present invention, the operating system automatically loads the drivers and other files from the CROM. Thus, this invention provides for automatic loading of drivers for IEEE 1394-enabled devices.

FIG. 1 is a schematic diagram of a conventional general-purpose digital-computing environment that can be used to implement various aspects of the present invention. A computer 100 includes a processing unit 110, a system memory 120 and a system bus 130 that couples various system components including the system 5 memory to the processing unit 110. The system bus 130 may be any of several types of bus structures including a memory bus or memory controller, a peripheral bus, and a local bus using any of a variety of bus architectures. The system memory 120 includes a read only memory (ROM) 140 and a random access memory (RAM) 150.

A basic input/output system (BIOS) 160 containing the basic routines that help 10 to transfer information between elements within the computer 100, such as during start-up, is stored in ROM 140. Computer 100 also includes a hard disk drive 170 for reading from and writing to a hard disk (not shown), a magnetic disk drive 180 for reading from or writing to a removable magnetic disk 190, and an optical disk drive 191 for reading from or writing to a removable optical disk 192, such as a CD ROM 15 or other optical media. Hard disk drive 170, magnetic disk drive 180, and optical disk drive 191 are respectively connected to the system bus 130 by a hard disk drive interface 192, a magnetic disk drive interface 193, and an optical disk drive interface 194. The drives and their associated computer-readable media provide nonvolatile storage of computer readable instructions, data structures, program modules and other 20 data for the computer 100. It will be appreciated by those skilled in the art that other types of computer readable media which can store data that is accessible by a computer, such as magnetic cassettes, flash memory cards, digital video disks, Bernoulli cartridges, random access memories (RAMs), read only memories (ROMs), and the like, may also be used in the exemplary operating environment.

A number of program modules can be stored on the hard disk, magnetic disk 190, optical disk 192, ROM 140 or RAM 150, including an operating system 195, one or more application programs 196, other program modules 197, and program data 198. In particular, the RAM 150 will, from time to time, store various device drivers, 5 as known in the art. A user can enter commands and information into computer 100 through input or selection devices, such as a keyboard 101 and a pointing device 102. The pointing device 102 may comprise a mouse, touch pad, touch screen, voice control and activation or other similar devices. Other input devices (not shown) may include a microphone, joystick, game pad, satellite dish, scanner, or the like. These 10 and other input devices are often connected to the processing unit 110 through a serial port interface 106 that is coupled to the system bus, but may be connected by other interfaces, such as a parallel port, a game port or a universal serial bus (USB). A monitor 107 or other type of display device is also connected to system bus 130 via an interface, such as a video adapter 108. In addition to the monitor, personal computers 15 typically include other peripheral output devices (not shown), such as speakers and printers.

An IEEE 1394 interface 140 may also be provided. The IEEE 1394 interface 140 couples an IEEE 1394-compliant serial bus 145 to the system bus 130 or similar communication bus. The IEEE 1394-compliant serial bus 145, as known in the art, 20 allows multiple devices 150 to communicate with the computer 100 and each other using high-speed serial channels. The IEEE 1394 high-performance serial bus standard is based largely upon the internationally adopted ISO/IEC 13213 (ANSI/IEEE 1212) CSR Architecture Specification and the IEEE 1394-1995 Serial Bus Specification, the teachings of which are herein incorporated by reference.

Additional buses such as the PCI bus can be provided in computer 100 and interfaced to the IEEE 1394 and other buses.

A typical serial bus having a IEEE 1394 standard architecture is comprised of a multiplicity of nodes that are interconnected via point-to-point links, such as cables, 5 that each connect a single node of the serial bus to another node of the serial bus. The nodes themselves are addressable entities that can be independently reset and identified. Nodes are logical entities, each with a unique address. Each node provides a so-called configuration ROM (read-only memory)--hereinafter referred to as configuration memory--and a standardized set of control registers that can be 10 accessed by software residing within the computer system.

The computer 100 can operate in a networked environment using logical connections to one or more remote computers, such as a remote computer 109. The remote computer 109 typically includes at least some of the elements described above relative to the computer 100, although only a memory storage device 111 has been 15 illustrated in FIG. 1. The logical connections depicted in FIG. 1 include a local area network (LAN) 112 and a wide area network (WAN) 113. Such networking environments are commonplace in offices, enterprise-wide computer networks, intranets and the Internet.

When used in a LAN networking environment, the computer 100 is connected 20 to local network 112 through a network interface or adapter 114. When used in a WAN networking environment, the computer 100 and remote computer 109 may both include a modem 115 or other means for establishing a communications over wide area network 113, such as the Internet. The modem 115, which may be internal or external, is connected to system bus 130 via the serial port interface 106. In a

networked environment, program modules depicted relative to the computer 100, or portions thereof, may be stored in the remote memory storage device.

It will be appreciated that the network connections shown are exemplary and other means of establishing a communications link between the computers can be
5 used. The existence of any of various well-known protocols, such as TCP/IP, “ETHERNET”, FTP, HTTP and the like, is presumed, and the system can be operated in a client-server configuration to permit a user to retrieve web pages from a web-based server. Procedures of the present invention to be described below can operate within the environment of the computer 100 shown in FIG. 1. Although the invention
10 is generally applicable to a computer operating in accordance with the IEEE 1394 standard, it is not intended to be so limited.

As shown in FIG. 2, one or more computers 200, 202 can be coupled to a communication medium such as a IEEE 1394 bus 204. And, of course, computers 200, 202 connected to a IEEE 1394 bus 204 have IEEE 1394 bus interfaces 206, 208
15 that enable communication with the computers and other peripherals 210, 212 coupled to the bus. The peripherals 210, 212 similarly have IEEE 1394 bus interfaces 214, 216 that enable communication with the computers as well as other peripherals on the bus 204.

The peripherals 210, 212 also each include a configuration read-only memory
20 (CROM) 218, 220. Although a CROM is customarily used in IEEE 1394-enabled devices 210, 212, any non-volatile memory could be used including, but not limited to, the computer-readable memory examples provided above. In any event, a memory device such as a CROM is preferably used because IEEE 1394 serial devices typically include a ROM directory structure that provides information needed to configure and
25 diagnose problems associated with the peripheral device 210, 212. Information

included within the CROM may include information for: identifying the software driver for the device 210, 212, identifying diagnostic software, specifying bus-related capabilities of the device (e.g. whether the device is bus manager capable), and specifying optional module, node, and unit characteristics and parameters.

5 In addition to the foregoing, the present invention preferably includes one or more drivers (and/or other installation/configuration files) for each operating system with which the peripheral device 210, 212 is intended to operate. For example, the CROM for a device might have drivers for Microsoft Windows® 98, Linux, and/or any other operating system. Thus, any computer 200, 202 connected to the IEEE
10 1394 bus 204 could load the necessary drivers directly from the peripheral device 210,
 212 as soon as the device is detected. This is a significant advantage over the prior art
 because the computers 200, 202 could automatically load the drivers without
 requiring user intervention. Current “Plug And Play” and “System File Protection”
 security mechanisms can still be used so only signed driver software can be installed
15 and downloaded from the device.

 In an alternate embodiment, the CROM 218, 220 could store—in addition to drivers or in lieu of drivers—a uniform resource locator (URL) or other pointer to a location that contains the drivers (and/or other installation/configuration files) for various operating systems and devices. Of course, the location could be a local
20 computer-readable medium, network storage device, and/or any site on the Internet.
 After a computer 200, 202 detects a device 210, 212, the computer could check the CROM 218, 220 for a driver, see the URL or pointer for its particular driver, and then proceed to automatically procure and load the driver without user intervention. This approach would have the added benefit of ensuring that the computers 200, 202
25 always load the current version of the driver.

A flow chart illustrating an exemplary process of automatically loading device drivers is shown in FIG. 3. An operating system running on a computer 200, 202 is first started at S300. After the operating system is running, the computer 200, 202 can then detect at S302 whenever a device 210, 212 is connected to the bus 204. The 5 device 210, 212 is available to be enumerated the moment it is plugged in. It is always free in this sense since the invention does not need to be able to determine what drivers to load in the normal case, the operating system will check to see if the CROM 218, 220 stores drivers or pointers to drivers at S308. If the CROM does not store the drivers or pointers, then the operating system will conclude that the peripheral device 10 is a legacy device. Consequently, the operating system will prompt its user to manually load the driver in the standard prior-art way of loading drivers S310.

However, if the CROM 218, 220 does store drivers (or pointers), then the operating system will preferably check the first driver to see if it is suitable for use with the operating system at S312. Of course, if the driver is suitable, the operating 15 system will load the driver stored in the CROM at S314. If the driver is not suitable, the operating system will check to see if the CROM contains any other drivers at S316. The present invention will continue this process until it finds the correct driver or runs out of drivers to check. If a suitable driver is found, then it is loaded at S314. If a suitable driver is not found, then the operating system will conclude that the 20 peripheral device is a legacy device and will prompt its user to manually load the driver in the standard prior-art way of loading drivers at S310. Thus, by utilizing this method, each computer 200, 202 coupled to the IEEE 1394 bus 204 can automatically load drivers for peripheral devices coupled to the bus.

In sum, the present invention overcomes the limitations and problems of the 25 prior art by providing an automated solution for installing device drivers on IEEE

1394-enabled devices. In particular, this invention overcomes the problems of the prior art by storing device drivers (and/or other installation/configuration files) for one or more operating systems on a peripheral device's configuration ROM (CROM) or other non-volatile memory. When the device is connected to a IEEE 1394 bus,

5 each computer's operating system will automatically detect the device and poll the device to determine whether the driver information is stored in the CROM. If the device is a legacy device, the user is instructed to manually load the requisite drivers.

If the device is manufactured in accordance with the present invention, the operating system automatically loads the drivers and other files from the CROM. Thus, this

10 invention provides automatic loading of drivers for IEEE 1394-enabled devices.

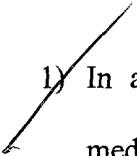
The present invention has been described herein with reference to specific exemplary embodiments thereof. It will be apparent to those skilled in the art, that a person understanding this invention may conceive of changes or other embodiments or variations, which utilize the principles of this invention without departing from the

15 broader spirit and scope of the invention as set forth in the appended claims. For example, instead of being implemented in conjunction with IEEE 1394 architecture, the present invention could be used with any serial bus or other communication medium. All are considered within the sphere, spirit, and scope of the invention. The specification and drawings are, therefore, to be regarded in an illustrative rather than

20 restrictive sense. Accordingly, it is not intended that the invention be limited except as may be necessary in view of the appended claims.

CLAIMS

What is claimed is:



- 1) In a system including at least one computer coupled through a communication medium to at least one device having at least one driver stored in memory on the device, a method of automatically loading the driver comprising the steps of:
 - a) detecting that the device is coupled to the communication medium;
 - b) determining whether the driver is stored in memory on the device; and
 - c) if the driver is suitable for usage with the computer, loading the driver from the memory on the device to the computer.
- 2) The method of claim 1 further comprising the step of prompting a user for a second driver that is suitable for usage with the computer if the driver stored in the memory was not suitable.
- 3) The method of claim 1 wherein the communication medium is a IEEE 1394 compliant bus and the device is a IEEE 1394-enabled device.
- 4) The method of claim 3 wherein the memory is a configuration read-only memory stored on the IEEE 1394-enabled device.
- 5) A computer-readable medium having computer-executable instructions for performing the steps recited in claim 4.

6) In a system including at least one computer running an operating system and at least one device having at least one driver stored in a configuration read-only memory (CROM) on the device, the computer and device coupled through an IEEE 1394 bus, a method of automatically loading the driver comprising the steps of:

- a) the operating system on the computer detecting that the device is coupled to the bus;
- b) the operating system on the computer polling the device in order to determine whether the driver stored on the CROM in the device is suitable for operation with the operating system on the computer; and
- c) if the driver stored in the CROM is suitable, loading the driver into the operating system.

7) The method of claim 6 further comprising the step of the operating system issuing a prompt on the computer for a second driver to be loaded if the driver stored on the CROM was not suitable.

8) A computer-readable medium having computer-executable instructions for performing the steps recited in claim 7.

9) In a system including at least a first computer running a first operating system and at least one device having at least first and second drivers stored in a non-volatile

memory on the device, the computer and device coupled through a communication bus, a method of automatically loading the drivers comprising the steps of:

- a) the first operating system on the first computer detecting that the device is coupled to the communication bus;
- b) the first operating system determining whether the memory on the device contains any said drivers for the device;
- c) the first operating system determining whether the first driver stored in the memory is suitable for use with the first operating system and the first computer;
- d) if the first driver is suitable, the first operating system loading the first driver from the memory;
- e) if the first driver is not suitable, the first operating system determining whether the second driver stored in the memory is suitable for use with the first operating system and the first computer; and
- f) if the second driver is suitable, the first operating system loading the second driver from the memory.

10) The method of claim 9 wherein the system also includes a second computer running a second operating system, the method further comprising the steps of:

- a) the second operating system on the second computer detecting that the device is coupled to the communication bus;
- b) the second operating system determining whether the memory on the device contains any said drivers for the device;

- c) the second operating system determining whether the first driver stored in the memory is suitable for use with the second operating system and the second computer;
- d) if the first driver is suitable, the second operating system loading the first driver from the memory;
- e) if the first driver is not suitable, the second operating system determining whether the second driver stored in the memory is suitable for use with the second operating system and the second computer; and
- f) if the second driver is suitable, the second operating system loading the second driver from the memory.

11) The method of claim 10 further comprising the step of the first operating system prompting a user to manually load a third driver that is suitable for usage with the first computer and the first operating system if neither the first or second drivers were suitable for usage with the first computer and the first operating system.

12) The method of claim 11 further comprising the step of the second operating system prompting a user to manually load a fourth driver that is suitable for usage with the second computer and the second operating system if neither the first or second drivers were suitable for usage with the second computer and the second operating system.

13) The method of claim 12 wherein the communication bus is a IEEE 1394 compliant bus and the device is a IEEE 1394-enabled device.

14) The method of claim 13 wherein the memory is a configuration read-only memory (CROM) stored on the IEEE 1394-enabled device.

15) The method of claim 14 wherein said first driver is compiled for said first operating system and said second driver is compiled for said second operating system.

16) The method of claim 14 wherein the CROM contains at least one additional driver in addition to the first and second drivers.

17) The method of claim 16 wherein the first operating system is different than the second operating system.

18) A computer-readable medium having computer-executable instructions for performing the steps recited in claim 17.

~~19)~~ A computer-readable medium having computer-executable instructions for performing steps comprising:

- a) running a first operating system on a first computer that is connected to a communication bus;
- b) detecting whether a device is connected to the communication bus;
- c) determining whether a non-volatile memory in the device contains a first driver that is suitable for use with the first operating system and first computer;

- d) loading the first driver if it is suitable;
- e) if the first driver is not suitable, determining whether the non-volatile memory in the device contains a second driver that is suitable for use with the first operating system and the first computer; and
- f) loading the second driver if it is suitable.

20) The computer-readable medium of claim 19 further comprising instructions for the first operating system issuing a prompt on the computer for a third driver to be loaded if the drivers stored on the non-volatile memory were not suitable.

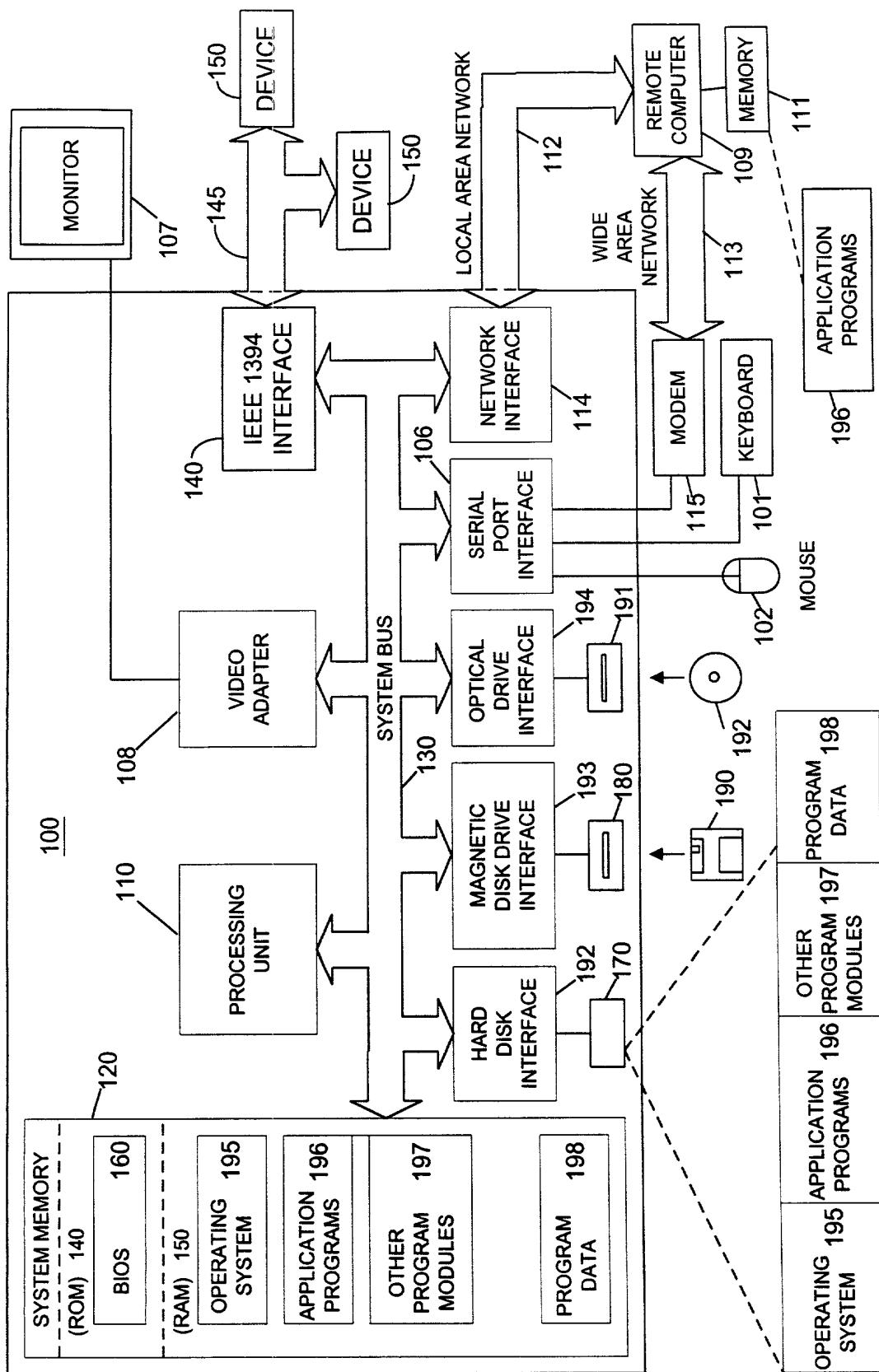
21) The computer-readable medium of claim 20 wherein the communication bus is a IEEE 1394-compliant bus and the device is a IEEE 1394-enabled device.

22) The computer-readable medium of claim 21 wherein the non-volatile memory is a configuration read-only memory (CROM).

23) The computer-readable medium of claim 21 wherein the CROM also includes at least one uniform resource locator (URL) identifying a location where at least one current driver is stored.

ABSTRACT OF THE DISCLOSURE

The present invention discloses methods and apparatus for automatically loading drivers on computers for devices coupled to a communication medium such as an IEEE 1394 serial bus. Operating systems running on the computers detect when a device is connected to the communication medium. The operating systems then determine whether one of the drivers stored in memory on the device will enable the computers to utilize the device. Alternatively, the memory could store—in addition to drivers or in lieu of drivers—a uniform resource locator (URL) or other pointer to a location that contains the drivers (and/or other installation/configuration files) for various operating systems and devices. The operating systems will then load the appropriate drivers for their respective computers and allow access to the device. If none of the drivers on the memory are suitable for a particular computer, then its operating system will prompt a user to manually insert a computer-readable medium containing the appropriate drivers. Thus, the present invention provides methods and apparatus for automatically loading device drivers.



1

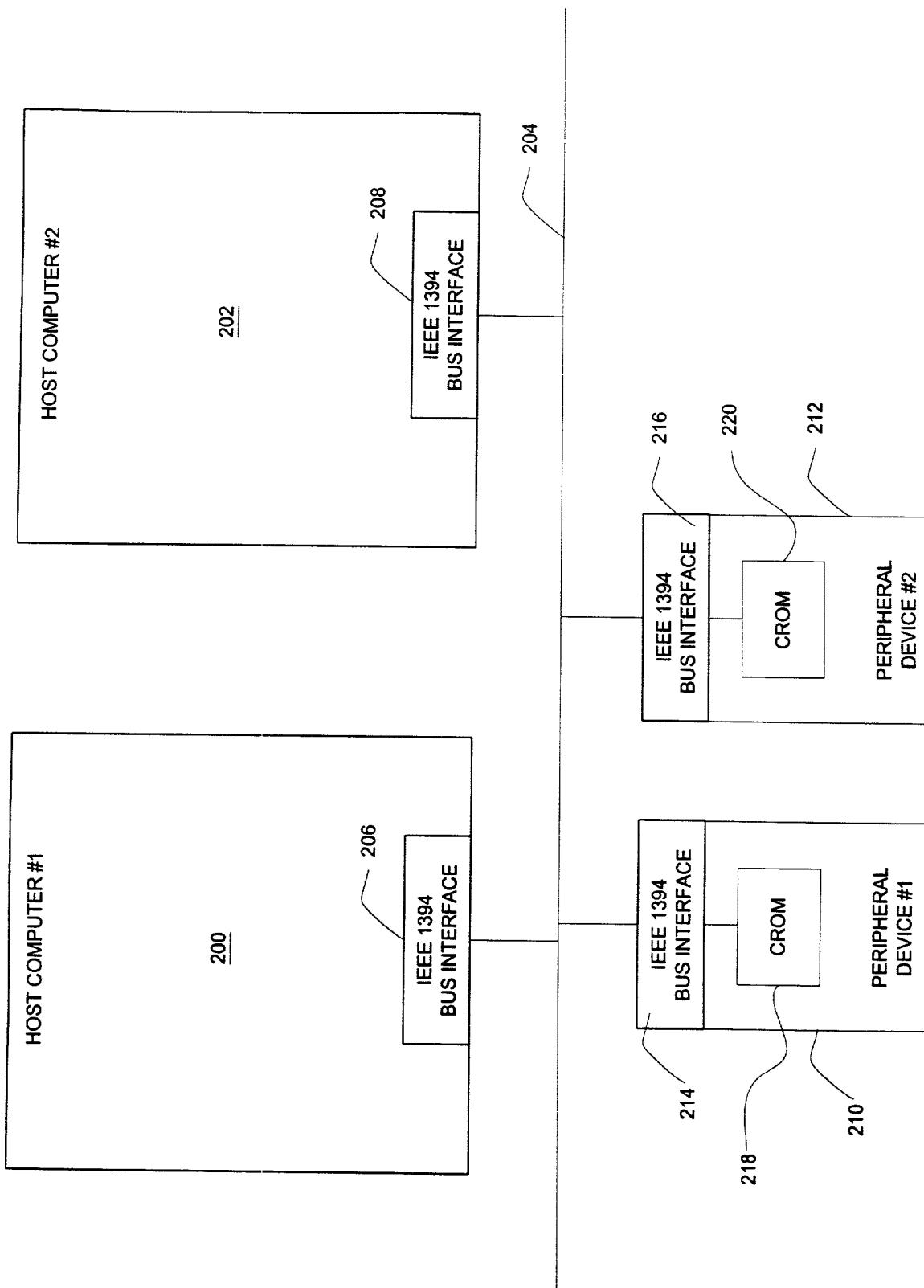


FIG. 2

FIG. 3

